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(54) **SURFACE ANNEALING OF COMPONENTS FOR SUBSTRATE PROCESSING CHAMBERS**

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(58) **Field of Classification Search**

None

See application file for complete search history.

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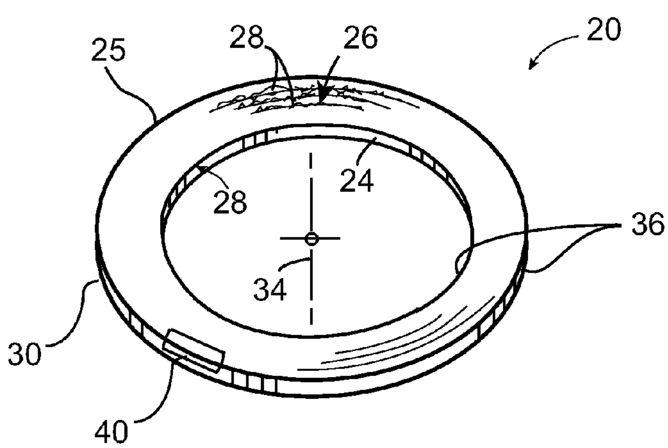
(57) **ABSTRACT**

A method of fabricating a processing chamber component comprises forming a processing chamber component having a structural body with surface regions having microcracks, and directing a laser beam onto the microcracks of the surface regions of the structural body for a sufficient time to heal and close off the microcracks by themselves.

20 Claims, 5 Drawing Sheets



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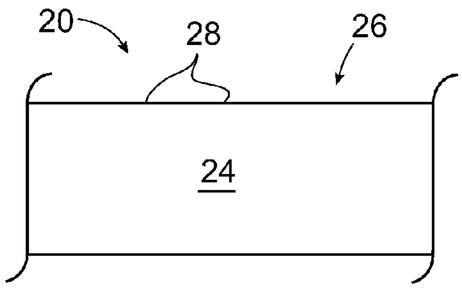

FIG. 1A

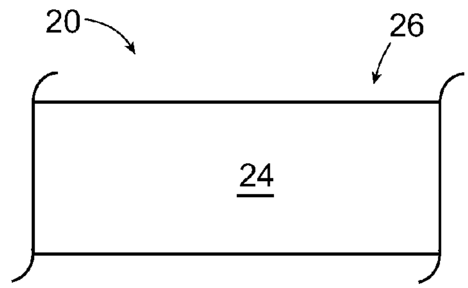

FIG. 1B

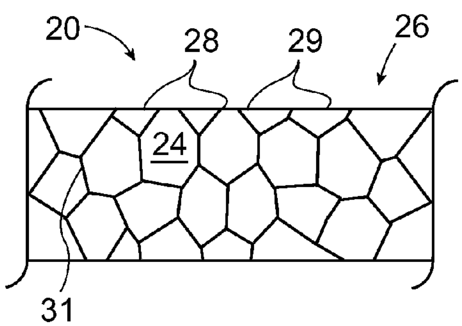

FIG. 1C

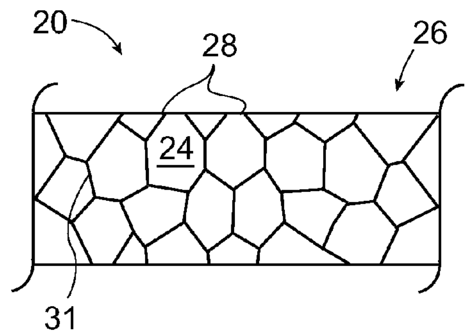

FIG. 1D

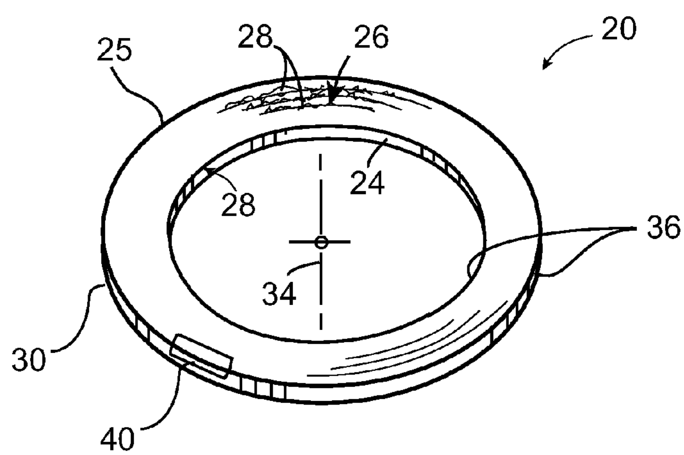

FIG. 2

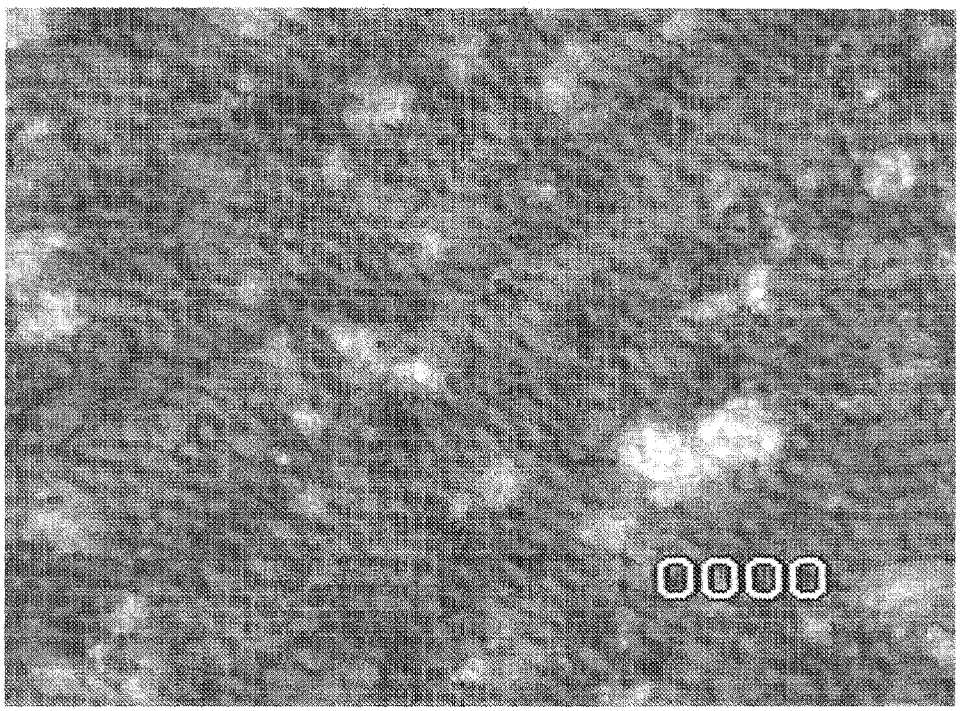

FIG. 3A

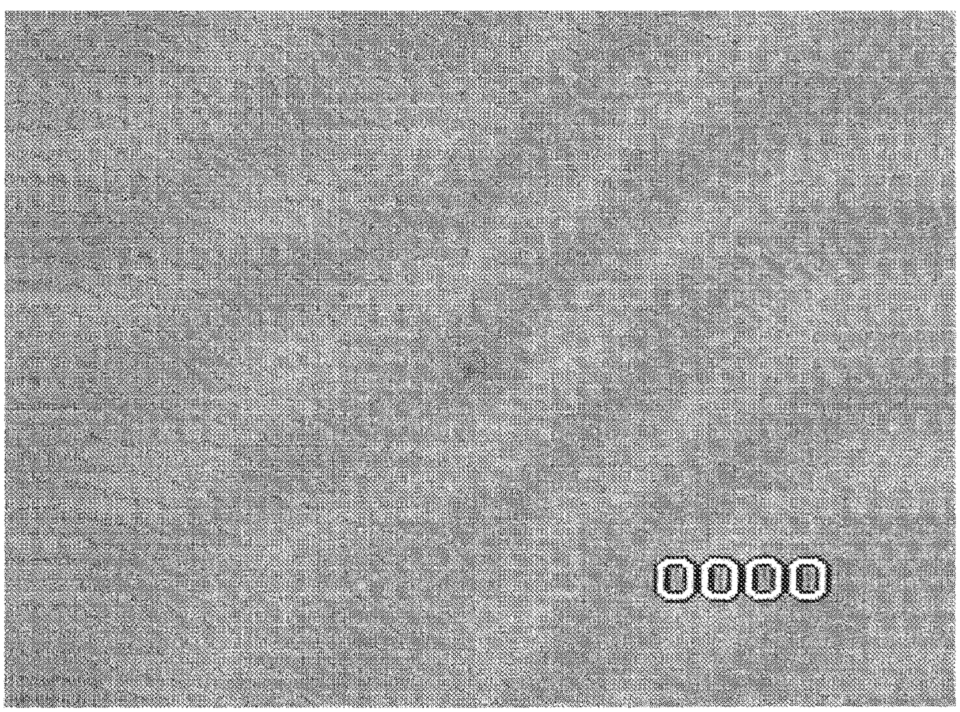

FIG. 3B

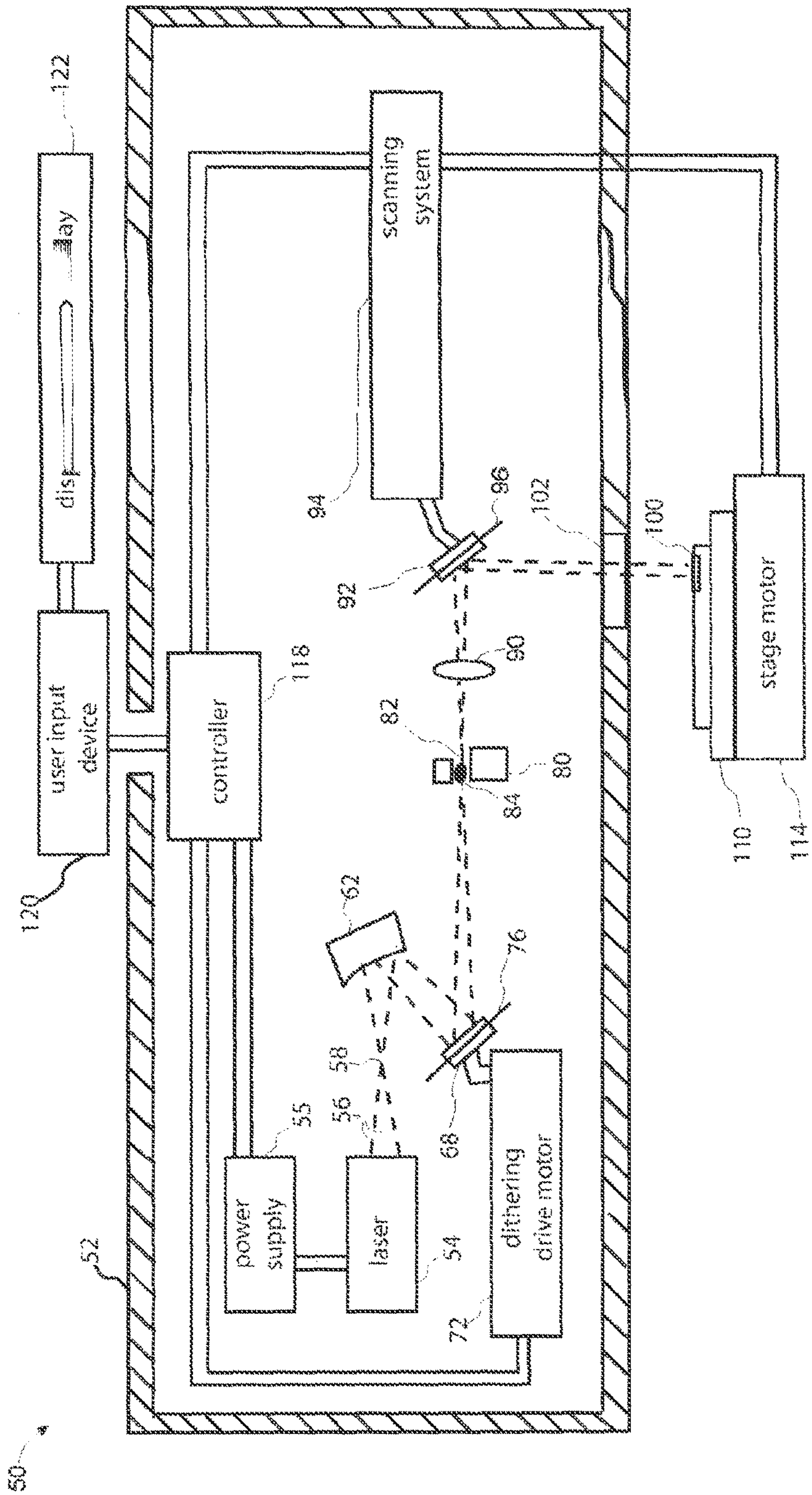
scanning system
user input device
controller
power supply
laser
dithering drive motor
stage motor
50
52
54
55
56
58
62
68
72
76
80
82
84
90
92
94
96
100
102
110
114
118
120
122

FIG. 4

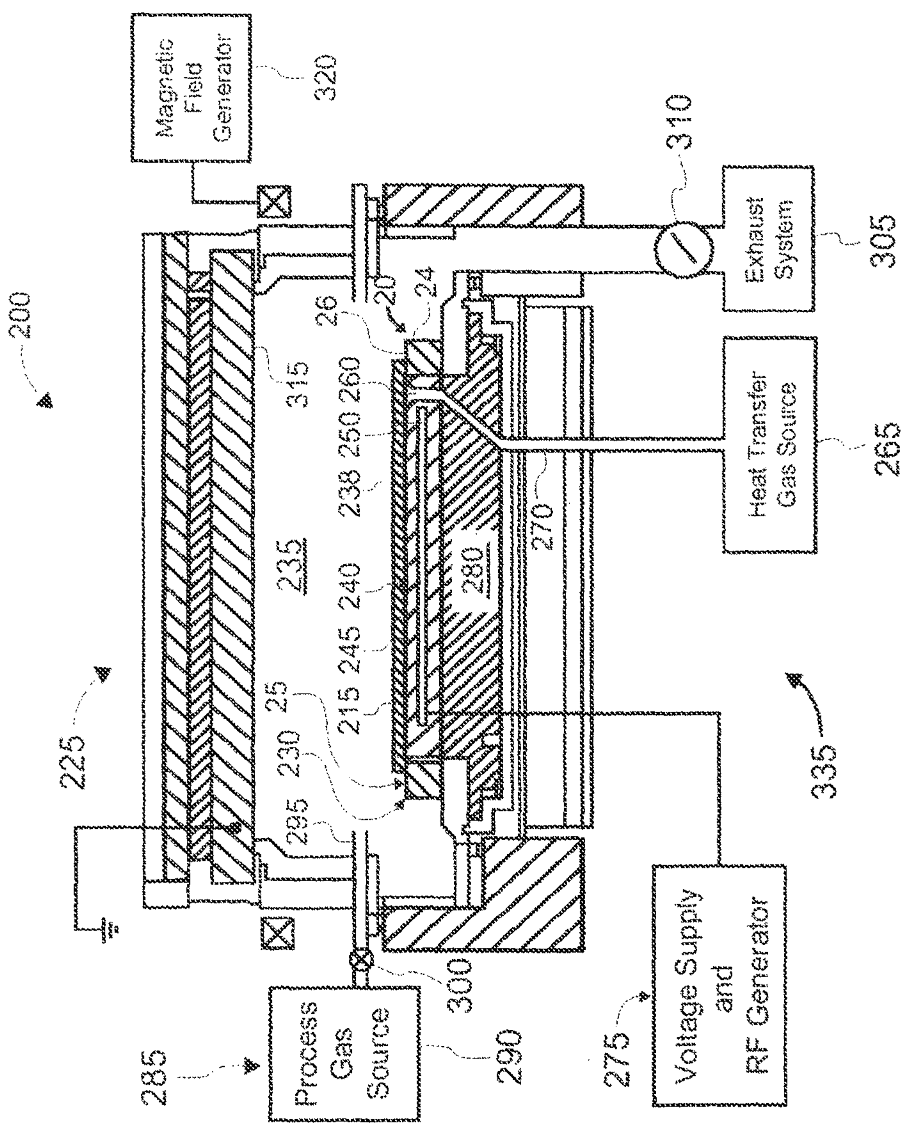
200
225
235
315
320
Magnetic Field Generator
310
Exhaust System
305
Heat Transfer Gas Source
265
270
280
26
24
20
260
250
238
240
245
215
25
230
295
300
Process Gas Source
285
290
Voltage Supply and RF Generator
275
335

FIG. 5

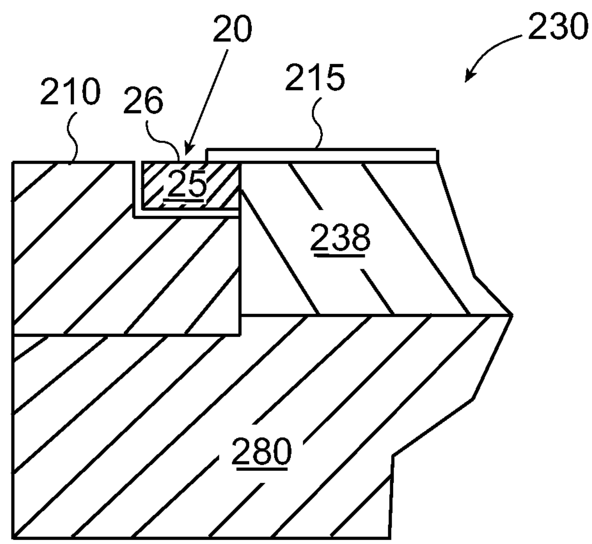

FIG. 6

SURFACE ANNEALING OF COMPONENTS FOR SUBSTRATE PROCESSING CHAMBERS

CROSS-REFERENCE

This application is a divisional of application Ser. No. 11/181,041, entitled "LOCALIZED SURFACE ANNEALING OF COMPONENTS FOR SUBSTRATE PROCESSING CHAMBERS", filed on Jul. 13, 2005, which is incorporated by reference herein in its entirety.

BACKGROUND

Embodiments of the present invention relate to components for substrate processing chambers.

A substrate processing chamber is used to process a substrate such as for example, a semiconductor wafer or display, in an energized process gas. The processing chamber typically comprises an enclosure wall that encloses a process zone into which a gas is introduced and energized. The chamber may be used to deposit material on the substrate by chemical or physical vapor deposition, etch material from a substrate, implant material on a substrate, or convert substrate layers such as by oxidizing layers or forming nitrides. The chamber typically includes a number of internal chamber components such as for example, a substrate support, gas distributor, gas energizer, and different types of liners and shields. For example, the liners and shields can be cylindrical members surrounding the substrate to serve as focus rings to direct and contain plasma about the substrate, deposition rings that prevent deposition on underlying components or portions of the substrate, substrate shields, and chamber wall liners.

Ceramic materials are often used to form the internal chamber components, especially those components that are exposed to the energized gas or plasma, and consequently, are subject to high temperatures and erosion. Ceramic materials such as alumina and silica are crystalline whereas silica glasses have no long range order. Ceramics typically exhibit good resistance to erosion by the energized gases, and consequently, do not have to be replaced as often as metal alloys. Ceramic components also reduce the generation of particles in the chamber that result from the erosion of components. Ceramic components can also withstand high temperatures without thermal degradation. Quartz components are particularly useful for plasmas that would corrode other materials, such as plasmas containing fluorine species.

However, ceramic materials are subject to brittle failure modes and often crack or chip in use in the chamber or during handling in the replacement or cleaning of the component. Amorphous and microcrystalline materials are particularly susceptible to brittle failure through crack propagation. In amorphous materials, such as glass, surface microcracks propagate on an atomic level because glass has short-range order without any long-range order. Microcrystalline materials, such as quartz, have grains with a surface that can have intragranular microcracks that are through single grains, intergranular microcracks that extend around grains and along grain boundaries, as well as transgranular microcracks that cut across adjacent grains. Of these, the intergranular microcracks that extend around the microcrystalline grains of the quartz are generally the most culpable for crack propagation and often lead to chipping and cracking of the component.

Thus, it is desirable to have a ceramic component made from microcrystalline or amorphous ceramics that exhibits reduced chipping and cracking. It is further desirable to fabricate such ceramic components with lower failure rates during use. It is also desirable for the ceramic components to be able to withstand the energized gas environment in the chamber without excessive erosion or thermal degradation.

SUMMARY

A method of fabricating a processing chamber component comprises forming a processing chamber component having a structural body with surface regions having microcracks, and directing a laser beam onto the microcracks of the surface regions of the structural body for a sufficient time to heal and close off the microcracks by themselves.

A method of fabricating a substrate processing chamber component comprises forming a processing chamber component having a structural body with surface regions having microcracks with crack surfaces, and annealing the microcracks to heal and close off the microcracks by themselves such that the crack surfaces of each microcrack are in contact with one another.

A method of fabricating a substrate processing chamber component comprises forming a processing chamber component having a structural body with localized surface regions having microcracks with crack surfaces. The microcracks are annealed by directing a laser beam on the localized surface regions for a sufficient time to heal and close off the microcracks by themselves such that (i) the crack surfaces of each microcrack are in contact with one another, and (ii) the annealed structural body has a mean Vickers hardness that is at least about 10% higher than the Vickers hardness of the untreated structural body.

DRAWINGS

These features, aspects, and advantages of the present invention will become better understood with regard to the following description, appended claims, and accompanying drawings, which illustrate examples of the invention. However, it is to be understood that each of the features can be used in the invention in general, not merely in the context of the particular drawings, and the invention includes any combination of these features, where:

FIG. **1**A is a cross-sectional schematic view of a chamber component made from glass showing microcracks in the surface of the glass;

FIG. **1**B is a cross-sectional schematic view of the chamber component of FIG. **1**A after localized laser treatment to anneal the surface microcracks;

FIG. **1**C is a cross-sectional schematic view of a chamber component made from quartz showing microcracks along the grains and grain boundary regions of the quartz;

FIG. **1**D is a cross-sectional schematic view of the chamber component of FIG. **1**C after localized laser treatment to anneal the surface microcracks;

FIG. **2** is a perspective view of a quartz ring having a laser annealed surface;

FIGS. **3**A and **3**B are optical microscopy images of a quartz surface with surface microcracks before and after laser treatment, respectively;

FIG. **4** is a schematic view of a laser annealing apparatus suitable for localized surface annealing of the chamber component;

FIG. **5** is a sectional schematic view of a substrate processing chamber that uses the ring of FIG. **2**; and

FIG. **6** is a schematic partial sectional side view of support assembly that uses the ring of FIG. **2** in the chamber of FIG. **5**.

DESCRIPTION

A substrate processing chamber component **20** comprises a structural body **24** with localized surface regions **26** having microcracks **28**, as shown in FIGS. **1**A to **1**D. The chamber component **20** can be made from a ceramic, glass or glass ceramic material, such as for example, quartz, silica glass, aluminum oxide, titanium oxide, silicon nitride, zirconium oxide, and other such materials. The surface microcracks **28** are caused by fine dust or other abrasive materials that strike and abrade the component surface **26** during or after fabrication of the component. FIG. **1**A shows a component **20** made from glass, which is amorphous and has short range atomic order but no long range atomic order. For example, silica glass has short range order within individual silica tetrahedrons with fixed silicon and oxygen bond angles, but the silica tetrahedral may be interconnected with random bond angles. In glass, the microcracks are very fine and terminate with atomic bonds. Microcrystalline ceramic materials, as shown in FIG. **1**C, are polycrystalline with fine grains **29** having micron sized dimensions. In microcrystalline materials, the microcracks **28** typically extend around the fine grains **29** and or along grain boundaries **31**, but they can also cut across single or adjacent grains **29**. The surface microcracks **28** on the components **20** serve as stress concentrators that cause applied forces to concentrate on the tips of the microcracks **20**. Because the dimensions of the microcracks **28** are very small, on the level of atomic bonds between atoms of the component material in glass materials, and on the level of micron sized grains in microcrystalline materials, the applied stress is magnified tremendously at the crack tip. This results in rapid catastrophic failure modes in which a portion of the component **20** can easily crack or chip away with even a small applied force or impact.

In one exemplary embodiment, the component **20** comprises a structural body **24** that is shaped as a ring **25**, as schematically illustrated in FIG. **2**. The ring **25** comprises the surface **26** having the microcracks **28**. The ring **25** is annular with an internal sidewall **28** and an external sidewall **30**. The internal sidewall **28** faces an internal axis **34** about which the structural body has rotational symmetry. The ring **25** is shaped to protect or conform to a section of a processing chamber, chamber component, or substrate within the chamber. For example, the component **20** can be a liner or shield that is a cylindrical member which is sized to fit around a substrate being processed in a chamber. The shield **20** can be a rig of quartz that surrounds the substrate. The component **20** can also be a deposition ring, shadow ring or cover ring. Yet other chamber components comprise chamber wall liners.

The surface microcracks **28** on the structural body **24** of the component **20** are annealed to heal and close off the microcracks as shown in FIGS. **1**B and **1**D, to reduce crack propagation and increase the fracture resistance of the component **20**. In one embodiment, a laser beam is directed onto the localized surface regions **26** of the component **20** at a sufficiently high intensity and for a sufficient time to cause the region **26** about the microcracks **28** to soften and heal the microcracks **28**. The laser beam is used to selectively heat the localized surface regions of the component **20**. The localized surface regions **26** are those that are prone to fracture during use, or which have excessive microcracks during fabrication, for example, regions which are more readily subject to abrasion and grinding from applied external forces during the handling of manufacture of the component. Thus, the localized surface regions may be on the flat top surface of the ring **25**. The localized surface regions **26** can also include those regions of the component **20** which are more susceptible to applied stresses during handling and use. For example, the edges **36** of the quartz rings **25** used in the chamber **20** are often chipped or cracked when the ring **25** is removed for cleaning or replacing after use for a predetermined number of process cycles. The edges **36**, which may also include corners **40**, are often easily cracked or chipped in use. Thus, increasing the fracture strength of the regions **26** of the quartz ring can significantly increase its process lifetime.

The energy of the laser beam and beam characteristics, such as focal length, beam shape and beam diameter, may be controlled to selectively heat a shallow portion of the localized surface region of the component **20** above the microcrack healing temperature needed for annealing the surface microcracks **28**. In one embodiment, a laser beam is used to heat a thin surface layer having a depth of less than 500 microns, and more typically less the 100 microns, of the localized surface regions **26** of a component **20**. The focused laser beam selectively heats the localized surface regions **26** of the component **20** to a temperature above the crack healing temperature without excessively raising the bulk temperature of the component, which may result in distortion or thermal fracture of the component **20**. After heating the thin surface layer of the component **20**, rapid quenching of the hot surface occurs simply by conduction of heat out of the surface into the ambient environment. Since only a very shallow portion of the localized surface region **26** is heated by the laser beam, the quench rate by natural conduction or convection is relatively fast.

While a laser beam heat treatment is described as an exemplary annealing process, other annealing processes can also be used. For example, alternative annealing processes include plasma jet heating, electrical arc heating, flame heating. Thus, the scope of the present invention should not be limited to the exemplary versions described herein, and the invention includes other localized surface annealing processes and apparatus as would be apparent to those of ordinary skill in the art.

The microcrack formation process is essentially partially or entirely reversed by the annealing step. The localized heat energy supplied to the microcracked surface by the laser causes softening and fluxing of the localized heated region causing the microcracks **28** to close and seal themselves off, as schematically shown in FIGS. **1**B and **1**D. It is believed that in amorphous or glassy materials, as shown in FIGS. **1**A and **1**B, the microcrack healing process is enhanced because atomic forces acting across the tips of the microcracks **28** tend to pull crack surfaces back into contact across the entire microcrack plane. In microcrystalline materials, as shown in FIGS. **1**C and **1**D, the grain boundary regions **31** often contain small amounts of impurities that act as fluxing agents causing more rapid fluxing and resultant healing of the microcrack surfaces.

The effects of the laser annealing treatment are shown in FIGS. **3**A and **3**B, which are optical microscopy images of a quartz surface comprising surface microcracks before and after laser treatment, respectively. FIG. **3**A shows the quartz surface with a large number of microcracks corresponding to the dark lines between the lighter grain surface regions. In FIG. **3**B, which is a photo of the laser treated sample, it is seen that most of the surface microcracks have disappeared to provide a smooth and continuous surface. Note also that an indentation mark was artificially made at the center of the quartz specimen. However, the size of the indentation mark was on the order of the surface roughness of the quartz material, consequently, it is not visible in the original, un-treated quartz material shown in FIG. **3**A. However, the partially healed indentation mark is visible as a faint dark spot in the photo of the laser treated sample of FIG. **3**B, because the surface of the laser treated specimen is smooth and absent surface microcracks and roughness.

Annealing of surface microcracks of the chamber components was also found to substantially increase hardness and fracture stress of the annealed material, which would significantly improve its resistance to chipping and cracking. In the hardness test, an increasing load was applied normal to the plane of the specimen surface using a micro-indenter having a known geometrical shape. The load is then reduced until the surface of the specimen partially or completely relaxes, and a depth of indentation is then measured. The load is then progressively increased and the indentation and measurement process repeated until hardness is compromised and the specimen cracks. The Vickers hardness is computed using the formula $H=P_{max}/A_c$, where P_{max} is the maximum load sustained before cracking and A_c is the projected area of contact of the indenter. The hardness was measured using a Nano Hardness Tester. The load applied was on the order of a nano Newton and the displacement was accurately determined using a differential capacitor sensor. Both an original untreated quartz specimen and a laser annealed quartz specimen were measured. The mean Vickers hardness index for the untreated specimen was about 771.68, and the Vickers hardness index for the laser annealed quartz specimen had a mean of 951.68. Thus, the laser annealed quartz specimen had a Vickers hardness which was at least about 10%, and more preferably at least about 25% harder than the untreated specimen.

Another measurement demonstrating increased crack and chip resistance is a fracture stress measurement. Ceramic materials are often tested in a flexural or bending test instead of tensile test because of their brittle nature. The stress at which the ceramic material fails by fracture is called the fracture stress or fracture strength of the material. The fracture stress of untreated and laser annealed quartz specimens were compared from a 4-point bending test performed on the Universal Testing Machine according to ASTM C1161-90. The load at fracture and a cross-sectional area of the specimen was used to compute the stress fracture from the formula σ=Load/wxt, where wxt is cross sectional area over which the load is applied. The mean fracture stress of the untreated quartz specimens was 86.23 MPa and the mean fracture stress of the laser annealing quartz specimen was 132.27 MPa. Thus, the mean fracture stress of the laser annealed quartz specimen was at least about 25%, and more preferably, at least about 50% higher than that of the untreated specimen.

Thus, annealing of the microcracks **28** in localized surface regions **26** of a component **20** can significantly increase the surface smoothness, hardness, and fracture strength of the component **20**. Absence or reduction of microcracks **28** in the surface of the component **20**, especially in regions which are susceptible to applied stresses or are simply more fragile, such as projections, corners **40** and edges of the component, substantially increases the crack and chip resistance of the component **20**. Advantageously, surface annealing allows healing and increased strength of selected surface regions **26** without subjecting the entire component **20** to elevated temperatures that may cause structural deformation or other thermal degradation. However, the entire component **20** may also be annealed by suitable heat treatment.

Annealing of the microcracks **28** in localized surface regions **26** of the component **20** can be performed using a laser annealing apparatus **50**, an exemplary embodiment of which is shown in FIG. **4**. The laser annealing apparatus **50** comprises a laser beam enclosure **52** that encloses a laser beam source **54** powered by a power supply **55**. Suitable laser beam sources **54** that can be used for microcrack annealing include, for example, Ar (argon), CO_2 and KrF lasers. An argon laser transmits in the visible wavelength at about 5145 angstroms. A CO_2 laser is an infra-red energy source having a wavelength of 10.6 μm, and can provide beams having a power of the order of 10 kilowatts. The CO_2 laser is 100× more efficient than the argon laser and is of greater intensity, allowing much faster scan speeds and larger spot sizes than the argon laser. A CO_2 laser is described in U.S. Pat. No. 3,702,973 issued on Nov. 14, 1972, which is incorporated herein in its entirety. Yet another type of laser is a KrF excimer laser having a wavelength of about 248 nm, an Eg of 5.0 eV, an efficiency of about 3%, and an output energy of 350 mJ. The laser beam is typically a circular beam having a beam diameter of typically less than about 10 mm, and more typically from about 0.5 mm to about 4 mm. Thus, suitable laser beams can have wavelengths of from about 190 nm to about 10,600 nm. The laser is typically operated at a power level of from about 5 Watts to about 10,000 Watts.

The laser **50** produces a laser beam **56** that is focused at a primary focal point **58** and is re-imaged by a refocusing mirror **62** which provides a larger focal length, to a secondary focal point **84**. Between the refocusing mirror **62** and the secondary focal point **84** is the dithering mirror **68** which is connected to a dithering drive motor **72** which vibrates the dithering mirror **68** at a preselected frequency. The dithering drive motor **72** vibrates the dithering mirror **68** about an axis **76** substantially in the plane of the mirror **68** and transverse to the incident laser beam **56** focused by mirror. The dithered beam emanating from the dithering mirror **68** spatially oscillates an arc line which is transverse to the plane of the drawing in FIG. **1**.

Typically, the laser beam **56** has an intensity distribution across the beam diameter, also called the intensity profile or intensity shape of the beam, which depends on the type of laser **50**. A common beam profile shape is a Gaussian shape, and more typically a U-shaped intensity profile. Focusing of the laser beam changes the cross-sectional size of the beam but not its beam intensity distribution which remains Gaussian or U-shaped. One method of correcting for the Gaussian or U-shaped cross-section of the laser beam is to spatially oscillate the laser beam **56**, also known as dithering. The spatial oscillation of the laser beam **56** may be sinusoidal, sawtooth or square waves. Spatial oscillation or dithering of the laser beam **56** produces an average and more uniform intensity of radiation across the region scanned by the dithering beam. In one embodiment, the laser beam **56** has an approximate Gaussian distribution at its focal point and the spatial oscillation or dithering is sinusoidal. The dithering is produced by the dithering mirror **76** which oscillates back and forth on the axis **76** that is parallel to the plane of the mirror **76** and transverse to the plane of the dither. Typically, the dithered beam covers an area that at least twice as large as the undithered beam. For sinusoidal dithering, the average intensity at each point across the dithering beam projected on the localized surface region is approximately flat in the center region and with peaks at the opposite ends. The resulting intensity profile of the dithering beam is shaped like a square wave and provides a good intensity profile for scanning across the localized surface region in contiguous, overlapping sweeps. However, other beam shapes, such as sine wave shapes, can also be used with appropriately compensating laser scanning methods.

The dithered beam then passes through a beam width controlling aperture **80** having a controllable or predefined fixed aperture **82** at the second focal point **84**. The aperture **80** is located between the dithering mirror **76** and a second focusing system **90** which may be a scanning mirror or lens. The axis **76** of mirror **68** may be transverse or parallel to the plane of the drawing in FIG. **1**. The beam is then projected onto a scanning mirror **92** driven by a scanning system **94**. The scanning system **94** oscillates the mirror **92** on its axis **96** to sweep and scan the beam **56** back and forth over a selected localized region **100** on the chamber component being treated. The scanned beam passes through a window **102** in the enclosure **100**. The sweep rate of scanning mirror **92** is typically slower than the dither frequency of the dithering mirror **68**. For example, a focused CO_2 laser having a beam diameter of about 500 μm may be scanned at from about 1 mm/sec to about 100 mm/sec.

The scanning system communicates with an X-Y movable stage **110** which is driven by a stage motor **114**. The stage **110** can also be adapted to slide in the Z or vertical direction to change the beam width incident on the component. The scanning system **94** synchronizes the sweep rate of the scanning mirror **92** with the movement of the stage **110**, and consequently, the movement of the chamber component resting on the stage **110**, to uniformly scan the dithered and apertured beam across the component. The scanning parameters are selected to uniformly heat the localized surface region across which the beam is being scanned, by adjusting the scanning speed and pattern to compensate for the shape of the laser beam. For example, the intensity distribution of the beam **56** can contain rings around a central maximum and even a depression in the middle of the beam due to near field annular characteristics of the beam. Furthermore, it is also desirable to overlap the beam scans to compensate for any variation in the cross-sectional intensity of a laser beam—if the laser beam sweeps across the surface in raster-type scans without overlapping of beam scans, the depth of heat treatment may vary across the beam scan depending on the shape of the beam.

The laser beam annealing apparatus **50** further comprises a controller **118** which controls operation of the system and is connected to the power supply **55**, which powers the laser **54**, the dithering drive motor **72**, and the scanning system **94**. In addition, the controller **118** accepts input from a user input device **120** and displays input parameters, and scanning system information on a display **122**. The controller **118** can be a conventional computer having a central processing unit (CPU) connected to suitable memory devices, including random access memory and storage memory on disk drives, and interface cards and buses. The laser beam annealing apparatus **50** is capable of laser annealing localized surface regions across the component surface with good uniformity over the entire surface region.

A component **20** that is annealed to reduce or heal microcracks can be used in a substrate processing apparatus **200**, as schematically illustrated in FIG. **5**, which is used to fabricate substrates **215**, such as semiconductor wafers and displays. The apparatus **200** can be a MxP, MxP Super E, or eMax type etching chamber, which are from Applied Materials Inc., Santa Clara, Calif., and are generally described in commonly assigned U.S. Pat. Nos. 4,842,683 and 5,215,619 to Cheng et al; and U.S. Pat. No. 4,668,338 to Maydan et al, all of which are incorporated herein by reference in their entireties. An exemplary apparatus **200** may be used in a multi-chamber integrated system for processing semiconductor substrates as described in U.S. Pat. No. 4,951,601 to Maydan et al, which is also incorporated herein by reference in its entirety.

Generally, the apparatus **200** comprises a process chamber **225** and ancillary control, electrical, plumbing and support components. A support assembly **230** comprising a support **238** is provided to receive the substrate **215** in a process zone **235**. The support **238** may be an electrostatic chuck **240** comprising a dielectric **45** at least partially covering an electrode **250**, and having gas outlets **260** through which a heat transfer gas, such as helium, may be passed from a heat transfer gas source **265** via gas conduits **270**, to control the temperature of the substrate **215**. Alternatively, the support **238** may be a vacuum or mechanical chuck or any other support as is known in the art. The electrode **250** is electrically charged by an electrode voltage supply **275** to electrostatically hold the substrate **215**. A base **280** below the electrostatic chuck **240** may optionally contain a heat exchanger, such as channels through which a heat transfer fluid may be circulated.

Process gas is introduced into the chamber **225** through a gas supply **285** that includes a gas source **290** and one or more gas nozzles **295** terminating in the chamber **225**. The gas nozzles **295** may be located around the periphery of the substrate **215** (as shown) or in a showerhead mounted on the ceiling of the chamber (not shown). A gas flow controller **300** is used to control the flow rate of the process gas. Spent process gas and byproducts are exhausted from the chamber **225** through an exhaust system **305**. The exhaust system **305** typically comprises an exhaust conduit leading to a plurality of pumps, such as roughing or high vacuum pumps, that evacuate the gas in the chamber **225**. A throttle valve **310** is provided in the exhaust conduit to control the pressure of the gas in the chamber **225**.

An energized gas, such as for example a gaseous plasma, is generated from the process gas by a gas energizer **275** that couples electromagnetic energy, such as RF or microwave energy, to the process gas in the process zone **235** of the chamber **225**. For example, the gas energizer **275** may comprise a first process electrode **315** such as an electrically grounded sidewall or ceiling of the chamber and a second electrode which may be the electrode **250** in dielectric **245**. The first and second electrodes **315**, **250** are electrically biased relative to one another by an RF voltage provided by an electrode voltage supply **275**. The frequency of the RF voltage applied to the electrodes **315**, **250** is typically from about 50 KHz to about 60 MHz. In other versions, the gas energizer **275** may also or alternatively include an inductor antenna (not shown) comprising one or more coils to inductively couple RF energy to the chamber **225**. The capacitively generated plasma may be enhanced by electron cyclotron resonance in a magnetically enhanced reactor in which a magnetic field generator **320**, such as a permanent magnet or electromagnetic coils, provides a magnetic field in the chamber **225** that has a rotating magnetic field having an axis that rotates parallel to the plane of the substrate **215**.

The chamber **225** may also comprise one or more process monitoring systems (not shown) to monitor the processes being performed on the substrate **215**. A typical process monitoring system comprises an interferometric system that measures an intensity of light reflected from a layer being processed on the substrate **215**, or a plasma emission analysis system that measures a change in light emission intensity of a gas species in the chamber **225**. The process monitoring system is useful to detect an endpoint of a process being performed on the substrate **215**.

The laser annealed component **20** such as the ring **25** is fitted around the substrate support **238** of the support assembly **230** in the chamber **225**. The ring **25** may protect the support assembly **230**, for example, the dielectric **245** of the electrostatic chuck **240** from erosion by preventing contact of the dielectric **245** with the energized process gas in the chamber **225**. Alternatively, the ring **25** may have other uses in the support assembly **230**.

Referring to FIG. **6**, additional structures, such as the collar **210** which surrounds the ring **25** can also be laser annealed to reduce surface microcracks. The collar **210** can be made from a ceramic material such as aluminum oxide or silicon oxide. The collar **210** may serve as a shield, which together with the ring forma replaceable process kit for the chamber. Other annular structures such as chamber wall liners can also be laser annealed, and can also be part of the process kit for the chamber **225**.

Although exemplary embodiments of the present invention are shown and described, those of ordinary skill in the art may devise other embodiments which incorporate the present invention, and which are also within the scope of the present invention. For example, the annealed chamber component **20** can be from chamber components such as the ceiling or walls of the chamber **225**. In addition, alternative methods of surface annealing can also be used. Furthermore, relative or positional terms shown with respect to the exemplary embodiments are interchangeable. Therefore, the appended claims should not be limited to the descriptions of the preferred versions, materials, or spatial arrangements described herein to illustrate the invention.

What is claimed is:

1. A method of fabricating a processing chamber component, the method comprising:

(a) forming a processing chamber component having a structural body with surface regions having microcracks; and

(b) directing a laser beam onto the microcracks of the surface regions of the structural body for a sufficient time to heal and close off the microcracks by themselves and provide a mean Vickers hardness that is at least about 10% higher than the Vickers hardness of the untreated structural body.

2. A method according to claim **1** wherein the surface regions having the microcracks are localized surface regions, and wherein (b) comprises scanning the laser beam across the localized surface regions.

3. A method according to claim **2** wherein the localized surface regions are edges of the structural body.

4. A method according to claim **1** wherein each microcrack has crack surfaces, and wherein (b) comprises directing the laser beam onto the microcracks for a sufficient time to cause the crack surfaces of each microcrack to contact one another.

5. A method according to claim **1** wherein each microcrack has a microcrack plane and crack surfaces, and wherein (b) comprises directing the laser beam onto the microcracks for a sufficient time to cause the crack surfaces of each microcrack to contact one another across the entire microcrack plane.

6. A method according to claim **1** wherein (b) comprises directing the laser beam onto the microcracks for a sufficient time to provide an annealed structural body having a mean fracture stress that is at least about 25% higher than the untreated structural body.

7. A method according to claim **1** comprising generating the laser beam with a CO_2 laser.

8. A method according to claim **1** comprising directing a laser beam having a wavelength of from about 190 nm to about 10,600 nm.

9. A method according to claim **1** comprising directing a laser beam having a power level of from about 5 Watts to about 10,000 Watts.

10. A method according to claim **1** wherein (a) comprises forming a structural body comprising at least one of:

(i) rotational symmetry about an internal axis; and

(ii) that is a ring, plate or cylinder.

11. A method according to claim **1** wherein (a) comprises forming a structural body composed of a ceramic, glass or glass-ceramic.

12. A method according to claim **1** wherein (a) comprises forming a structural body composed of quartz.

13. A method of fabricating a substrate processing chamber component, the method comprising:

(a) forming a processing chamber component having a structural body with surface regions having microcracks with crack surfaces; and

(b) annealing the microcracks to heal and close off the microcracks by themselves such that the crack surfaces of each microcrack are in contact with one another and to provide an annealed structural body having at least one of (i) a mean Vickers hardness that is at least about 10% higher than the Vickers hardness of the untreated structural body, and (ii) a mean fracture stress that is at least about 25% higher than the untreated structural body.

14. A method according to claim **13** wherein the surface regions having the microcracks are localized surface regions, and wherein (b) comprises annealing the localized surface regions.

15. A method according to claim **13** wherein each microcrack has a microcrack plane, and wherein (b) comprises annealing the microcracks for a sufficient time to cause the crack surfaces of each microcrack to contact one another across the entire microcrack plane.

16. A method according to claim **13** wherein (a) comprises forming a structural body comprising at least one of:

(i) that is composed of a ceramic, glass, glass-ceramic or quartz;

(ii) that has a rotational symmetry about an internal axis; and

(iii) that is a ring, plate or cylinder.

17. A method of fabricating a substrate processing chamber component, the method comprising:

(a) forming a processing chamber component having a structural body with localized surface regions having microcracks with crack surfaces; and

(b) annealing the microcracks by directing a laser beam on the localized surface regions for a sufficient time to heal and close off the microcracks by themselves such that (i) the crack surfaces of each microcrack are in contact with one another, and (ii) the annealed structural body has a mean Vickers hardness that is at least about 10% higher than the Vickers hardness of the untreated structural body.

18. A method according to claim **17** comprising directing a laser beam on the localized surface regions for a sufficient time to form an annealed structural body having a mean fracture stress that is at least about 25% higher than the untreated structural body.

19. A method according to claim **17** wherein each microcrack has a microcrack plane, and wherein (b) comprises directing the laser beam onto the microcracks for a sufficient time to cause the crack surfaces of each microcrack to contact one another across the entire microcrack plane.

20. A method according to claim **17** wherein (a) comprises forming a structural body comprising at least one of:

(i) that is composed of a ceramic, glass, glass-ceramic or quartz;

(ii) that has a rotational symmetry about an internal axis; and

(iii) that is a ring, plate or cylinder.

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